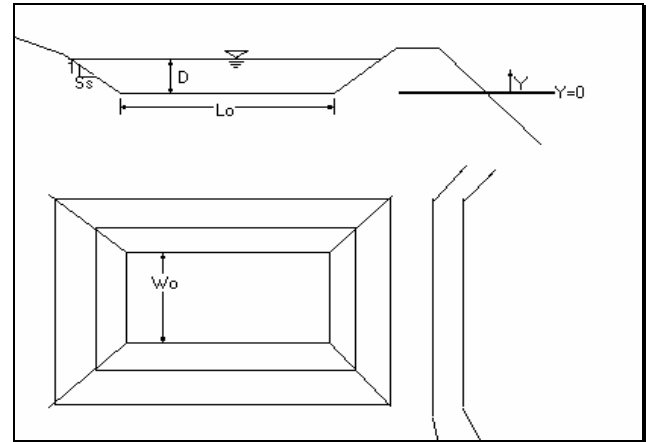


Reference Section 6-B

Pond Geometry Calculations

<Known>

Volume	(V)
Pond Depth	(D)
Side Slope	(S _s)
Length-to-Width Ratio	(R)



<Find>

Bottom Area of Rectangular Pond

<Solution>

Y = depth of section measured from bottom, from zero to D

W₀ = width at pond bottom

The pond width (W) at any depth, Y

$$W_Y = W_0 + 2S_s Y \quad \text{Eq. 1}$$

The pond length (L) at any depth, Y

$$L_Y = RW_0 + 2S_s Y \quad \text{Eq. 2}$$

The pond area at any depth, Y

$$A_Y = L_Y W_Y = (RW_0 + 2S_s Y)(W_0 + 2S_s Y) \quad \text{Eq. 3}$$

or,

$$A_Y = RW_0^2 + (R+1)2W_0 S_s Y + 4S_s^2 Y^2 \quad \text{Eq. 4}$$

The equation for the pond-full volume (V) is obtained by integrating between Y=0 and Y=D

$$V = \int_0^D \left(RW_0^2 + (R+1)2W_0 S_s Y + 4S_s^2 Y^2 \right) dY \quad \text{Eq. 5}$$

or,

$$V = \left[RW_0^2 Y + (R+1)W_0 S_s Y^2 + \frac{4}{3} S_s^2 Y^3 \right]_0^D \quad \text{Eq. 6}$$

or,

$$V = RDW_0^2 + S_s D^2 (R+1)W_0 + \frac{4}{3} S_s^2 D^3 \quad \text{Eq. 7}$$

Where

V = Volume of rectangular pond R = Length-to-width ratio

D = Depth Ss = Side Slope

W₀ = Bottom width

Rearrange equation to solve for W₀ using quadratic equation, $0 = ax^2 + bx + c$

$$0 = RDW_0^2 + S_s D^2 (R+1)W_0 + \frac{4}{3} S_s^2 D^3 - V \quad \text{Eq. 8}$$

Use Quadratic Equation to solve for positive solution of W₀, $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$$W_0 = \frac{-S_s D^2 (R+1) \pm \sqrt{[S_s D^2 (R+1)]^2 - 4RD \left(\frac{4}{3} S_s^2 D^3 - V \right)}}{2RD} \quad \text{Eq. 9}$$

Use Equation 2 for Length of pond at Y=0,

$$L_0 = RW_0$$

Use Equation 3 for Area of pond at Y=0,

$$A_0 = L_0 W_0 = RW_0^2$$